GEO 371c/391: Geomorphology: landscape process, form and evolution
Syllabus, Fall 2010

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I check email much more often than voicemail.

Office hours: MWF 3-4 (right after class), or by appointment.
Class website: TBD

Required readings: None
Recommended readings:

Textbook: Anderson and Anderson, *Geomorphology: the Mechanics and Chemistry of Landscapes*. Campus bookstore, Amazon, etc. Brand new, published July 2010. The class will draw most heavily from this book.

Free: Anderson, *The little book of Geomorphology: Exercising the Principle of Conservation.* http://instaar.colorado.edu/~andersrs/The_little_book_010708_web.pdf

Free: MIT online course ware, 12.163/463: Surface processes and Landscape Evolution. Download the Lecture Note PDFs in particular. http://ocw.mit.edu/courses/earth-atmospheric-and-planetary-sciences/12-163-surface-processes-and-landscape-evolution-fall-2004/index.htm

Free: Parker ebook. Great for open channel flow and sediment transport and channel dynamics, particularly if you prefer equations to English. Includes Excel visual basic codes that implement many of the equations. http://vtchl.uiuc.edu/people/parkerg/morphodynamics_e-book.htm

Other textbooks I find useful:

Leopold, Wolman and Miller, *Fluvial Processes in Geomorphology.* This is a small, cheap and classic book, published in 1964, written by legendary geomorphologists who wrote some of the most influential 20th century papers in the field. Even though it was written before an understanding of tectonics came together a few years later, the authors were way ahead of their time and the book is still readable and relevant.

Ritter, Kochel and Miller, *Process Geomorphology* Covers almost every topic, in almost enough detail to be useful. I do use it often to quickly look up basic information.

Field trips, 2 mandatory, which will form the basis of 2 major assignments:

Sept. 11, Saturday, Mandatory: Colorado River at Roy G. Guerrero Park, Austin (most likely).

Oct 2, Saturday: location TBD.

October 14-17 or 18, Thursday-Sunday or Monday: "Friends of the Pleistocene" trip to Henry Mtns, southeast Utah. Optional trip. This trip is likely to happen but not definite as the availability of departmental funds has not been finalized.

Assignments and grading: Class grades will be based on assignments, as there will be no tests.

There will be 4 major assignments, collectively worth 80% of your grade.

Three of these projects will entail data analysis and a thoughtful, coherent and well-written discussion of the results. The written reports will generally be limited to a maximum length of 4 pages (12 pt font, 1.5 spacing, not including figures or references), although details will be given in the individual assignments.

The 4th assignment will be a written evaluation of the current state of knowledge on a topic of interest within geomorphology, reading and evaluating at least 3 published papers on a research topic, pointing out limitations of the work and areas for future work.

In addition, there will be several smaller problem sets to demonstrate specific understanding of topics covered in class, collectively worth 20% of your grade.

Expectations will differ for undergraduate and graduate students, and assignments will be graded accordingly. Some assignments will have additional questions that are mandatory for grads, extra credit for undergrads.

Class participation: Active participation in mandatory field trips is required. While you are not required to come to lectures, but if you miss a lecture, I will be under no obligation to help you aquire or understand the information presented, whether in office hours, arranged meetings, or by giving you lecture notes in a timely manner.

Late assignment policy: Each day that an assignment is late will reduce the maximum attainable grade by 1/2 of a letter. i.e., a perfect assignment 1 day late would be worth 95%, 5 days late 75%, etc. But, the maximum attainable grade will stop decreasing at 60%, which means it will always be worthwhile to turn in late assignments, until the last day of the semester (Dec. 3).

Assignments will be due in class, and will be considered late once the lecture ends on that day.

Working together policy: I encourage you to work together on many aspects of these assignments, including discussing ideas and data analysis. However, I expect everyone to make

their own plots and figures, and the content of the final written reports and answers to specific questions must be your own. Everyone must turn in their own separate assignments.

Assignment due dates:

Sept 29 Wed: Major assignment #1 (field trip 1 report).
October 29 Fri: Major assignment #2 (field trip 2 report).
Nov 24, Wed: Major assignment #3, GIS/tectonic geomorphology.
Dec 3, Fri: Major assignment #4, topic of interest in surface processes.

The first smaller problem set will be due Friday Sept 10; others will be assigned during the semester.

Schedule of Topics:

Aug 25 wed: Class overview and logistics.
Aug 27 fri: A brief history of geomorphology, and big picture forcing: Gilbert and Davis and Penck and Tectonics and Climate.

OPEN CHANNEL FLOW AND SEDIMENT TRANSPORT

Aug 30 mon: open channel flow 1: Steady and Uniform, except in nature.
Sept 1 wed: open channel flow 2: Velocity profiles, Law of the Wall.
Sept 3 fri: open channel flow 3: Hydraulic roughness equations (e.g. Manning).
Sept 6, mon: labor day, no class.
Sept 8 wed: Sediment transport 1: Threshold of motion, non-dimension
al numbers.
Sept 10 fri: Sediment transport 2: Bedload transport.

FIELD TRIP: Saturday, Sept. 11, probably to Colorado River at Roy G. Guerrero Park, Austin.
Major assignment #1 is ... assigned.

sept 13 mon: Sediment transport 3: Suspended transport.
sept 15 wed: Sediment transport and river flow, 4: Aeolian transport and wrapup.

ALLUVIAL RIVERS AND LANDFORMS

sept 17 fri: Alluvial river morphologies and landforms.
sept 20 mon: channel morphology and feedbacks 1: width, depth, slope,hydraulic geometry, conservation of sediment (Exner).
sept 22, wed: channel morphology and feedbacks 2: Longitudinal profiles, downstream fining.
sept 24 fri Joel out of town, guest lecturer, TBD.
sept 27 mon: Why do rivers meander? Flow and transport through meander bends.
sept 29 wed: the landscapes of meandering rivers: levees and floodplains.
DUE: Major assignment #1 (field trip 1 report)

oct 1 fri: Braided rivers.

FIELD TRIP, Oct 2, Saturday: TBD

oct 4 mon: Alluviated mountain rivers: Step-pools and self-organization.
oct 6 wed: Bedrock rivers 1: Fluvial incision processes and bedrock channel morphology.
oct 8 fri: Speed=Dating: Cosmogenic radionuclides and other age constraints for surface processes.
oct 11 mon: Bedrock rivers 2: Rates of river incision; strath terrace formation.
oct 13 wed: A whole eroding landscape: Henry Mountains crash-course; slot canyons.

OPTIONAL FIELD TRIP: Thursday oct 14: group leaves for Utah.
oct 15 fri: Optional field trip, Henry Mtns.

HILLSLOPE PROCESSES AND MASS WASTING
oct 18 mon: Bedrock weathering and bedrock landscapes.
oct 20 wed: Hillslope hydrology.
oct 22 fri: Soil formation: rates, processes and climate sensitivity.
oct 25 mon: Diffusive soil transport and convex hillslope profiles.
oct 27 wed: Landslides and granular flows.
oct 29 fri: Debris flows 1: flow mechanics.
Major Assignment #2 due.
nov 1 mon: Debris flows 2: field evidence and landscape morphology.
nov 3 wed: Hillslope-channel coupling.
nov 5 fri: Climatic controls on landscape erosion.

TECTONIC GEOMORPHOLOGY
nov 8 mon: Tectonics from topography: Channel steepness and concavity
nov 10 wed: GIS lab, major assignment 3 assigned.
nov 12 fri: GIS lab
nov 15 mon: GIS lab
nov 17 wed: Climate-tectonics-erosion feedbacks; dynamic topography.
nov 19 fri: Thermochronology and rates of long-term rock uplift.
nov 22 mon: Tibet: structures and ages; lower crustal flow.
nov 24 wed: Paleoseismicity; fault-scarp diffusion dating.

Thanksgiving holiday: fri nov 26

nov 29 mon: Other landscapes 1: Eolian landforms and Mars.
dec 1 wed: Other landscapes 2: Mars and Titan.

dec 3 fri: last day of class:

Major assignment 4 due: paper on a topic of interest.

No final.

Learning objectives for the course:

Gain experience doing data analysis, and critically evaluate those data to address open-ended questions.

The NSF-supported Earth Science Literacy Principles: The Big Ideas and Supporting Concepts of Earth Science (www.earthscienceliteracy.org) is a list of nine "big ideas" and seventy-five "supporting concepts" considered to be essential geosciences knowledge. A large fraction of these interdisciplinary ideas are directly relevant to earth surface processes, including linkages between hydrology, ecology, and the land surface, complex feedbacks "within and between Earth's systems", glacial erosion, and bedrock weathering and sediment transport. Key examples given verbatim from the list include:

Big Idea 4. Earth is continuously changing.

4.7 Landscapes result from the dynamic interplay between processes that form and uplift new crust and processes that destroy and depress the crust. This interplay is affected by gravity, density differences, plate tectonics, climate, water, the actions of living organisms, and the resistance of Earth materials to weathering and erosion.

Big Idea 5. Earth is the water planet.

5.6 Water shapes landscapes. Flowing water in streams strongly shapes the land surface through weathering, erosion, transport, and deposition. Water participates in both the dissolution and formation of Earth's materials.

Big Idea 8. Natural hazards pose risks to humans.

8.3 Human activities can contribute to the frequency and intensity of some natural hazards. These hazards include floods, landslides, droughts, forest fires, and erosion.

Big Idea 9. Humans significantly alter the Earth.

9.6 Human activities accelerate land erosion. At present, the rate of global land erosion caused by human activities exceeds all natural processes by a factor of ten. These activities include urban paving, removal of vegetation, surface mining, stream diversions, and increased rain acidity.

Students with disabilities may request appropriate academic accommodations from the Division of Diversity and Community Engagement, Services for Students with Disabilities, 471-6259.